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|-------------------------------|------------------------|---------------------|--|
| <b>Notice of Allowability</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                               | 09/522,808             | MOLYNEAUX ET AL.    |  |
|                               | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                               | Tiffany A Fetzner      | 2859                |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 07/14/2004 & 05/24/2004.
2. ☒ The allowed claim(s) is/are 1-17, 25, 26, 36-41, and 45-78.
3. ☐ The drawings filed on \_\_\_\_\_ are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☐ All    b) ☐ Some\*    c) ☐ None    of the:
    1. ☐ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☒ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
  - (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
    - 1) ☒ hereto or 2) ☐ to Paper No./Mail Date 09/01/2004.
  - (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 09/01/2004.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

- |  |  |
|--|--|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)                                    |
| 2. <input checked="" type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 6. <input checked="" type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date <u>09/01/2004</u> . |
| 3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),<br>Paper No./Mail Date <u>05/24/2004</u> | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment  |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material                                 | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance                           |
|  | 9. <input type="checkbox"/> Other _____.   |

***Examiner's Amendment***

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney James S. Parker Reg. No. 40.119** on August 31<sup>st</sup> 2004 along with authorization to charge any necessary fees to applicant's deposit account.
3. The application has been amended as follows:

**A) Replace claim 1** of the May 25<sup>th</sup> 2004 amendment with the following **Examiner amended claim 1**:

**Claim 1** --- A magnetic resonance imaging system coil configuration, comprising:  
a radio frequency pair of coils in an opposite rotation orientation associated with a first magnetic field in a region of interest, wherein the region of interest is essentially within a cylinder created by the pair of coils;  
a radio frequency single coil associated with a second magnetic field in the region of interest, wherein the first magnetic field and the second magnetic field are substantially parallel in the region of interest, wherein the single coil is positioned at an essentially zero-flux contour with respect to the first magnetic field. ---

**B) Replace claim 11** of the May 25<sup>th</sup> 2004 amendment with the following **Examiner amended claim 11**:

**Claim 11** --- The configuration according to **claim 1**, wherein the zero-flux contour is located outside the pair of coils with respect to the length of the cylinder created by the pair of coils. ---

**C) Replace claim 38** of the May 25<sup>th</sup> 2004 amendment with the following **Examiner amended claim 38**:

**Claim 38** --- A magnetic resonance imaging system RF coil configuration, comprising:

at least five RF coils with bilateral symmetry, wherein the at least five RF coils are coaxial,

wherein said at least five RF coils are associated with a plurality of modes such that the number of modes is less than or equal to the number of RF coils, wherein said plurality of modes correspond with a plurality of current patterns, each of said plurality of current patterns having zero net mutual inductive coupling to each of the other of said plurality of current patterns in a region of interest. ---

**D) Replace claim 41** of the May 25<sup>th</sup> 2004 amendment with the following **Examiner amended claim 41**:

**Claim 41** --- A method of detecting magnetic fields in a magnetic resonance imaging system, comprising the following steps:

detecting a first magnetic field in a region of interest utilizing a radio frequency pair of coils in an opposite rotation orientation associated with the first magnetic field in the region of interest, wherein the first magnetic field and the second magnetic field are substantially parallel in the region of interest, wherein the region of interest is essentially within a cylinder created by the pair of coils; and

detecting a second magnetic field in the region of interest utilizing a radio frequency single coil associated with a second magnetic field in the region of interest, wherein the single coil is positioned at an essentially zero-flux contour with respect to the first magnetic field. ---

**E) Replace claim 51** of the May 25<sup>th</sup> 2004 amendment with the following **Examiner amended claim 51**:

**Claim 51** --- A method of detecting magnetic fields in a magnetic resonance imaging system, comprising:

positioning a radio frequency pair of coils in an opposite rotation orientation, wherein the pair of coils are associated with a first magnetic field in a region of interest, wherein the region of interest is essentially within a cylinder created by the pair of coils;

positioning a radio frequency single coil at an essentially zero-flux contour with respect to the first magnetic field, wherein the single coil is associated with a second magnetic field in the region of interest;

detecting the first magnetic field with the pair of coils; and

detecting the second magnetic field with the single coil. ---

**F) Replace claim 78** of the May 25<sup>th</sup> 2004 amendment with the following **Examiner amended claim 78**:

**Claim 78** --- A method of coil configuration for a magnetic resonance imaging system, comprising:

positioning at least five RF coils with bilateral symmetry, wherein the at least five RF coils are coaxial, wherein said at least five RF coils are associated with a plurality of modes such that the number of modes is less than or equal to the number of RF coils, wherein said plurality of modes correspond with a plurality of current patterns, each of said plurality of current patterns having zero net mutual inductive coupling to each of the other of said plurality of current patterns in a region of interest; and

detecting magnetic fields associated with the plurality of modes with the at least five RF coils. ---

### Examiner's Comment

4. The examiner has accepted applicant's Declaration Under 37 CFR 1.131, which was submitted July 13th 2004.
5. The examiner notes that the Exhibit A, laboratory page of final results shows a radio frequency single coil with two loops / windings / turns comprising the center solenoid, at the top of the page, and a radio frequency pair of coils, comprising counter rotating solenoids at the lower half of the page, or Helm holz pairs on the top of the following page. Each of applicant's CRC solenoids (i.e. the counter Rotating coil solenoids), or the helm holz pairs which comprise applicant's radio frequency pair of coils, are shown in the exhibit as also having two loops / windings / turns. The examiner also notes that the applicant's invention requires the combining of the single and paired coil configurations illustrated to generate applicant's claimed coil structure, and that the drawings do therefore support applicant's claims as recited in applicant's instant application, even though the different components of the claims are shown individually, as opposed to the specific combination claimed.
6. Exhibit B provided by applicant shows the profile coils system tests and SNR (i.e. signal-to-noise ratio) measurements performed by applicant prior to September 30<sup>th</sup> 1999 as sworn to by applicant in the declaration, which show the unexpected results that all four elements of the large shoulder test were OK in profile, and that the SNR for each of the different coils channels was substantially the same.
7. In view of applicant's Declaration Under 37 CFR 1.131, which was submitted July 13th 2004. The **Su et al.**, reference, US patent 6,493,572 B1 which has an effective filing date of September 30<sup>th</sup> 1999, **is no longer being applied by the examiner as prior art, because the examiner's position is that applicant has successfully sworn behind the date of this reference.** The examiner has also cited in this office action all of the art related to the **Su et al.**, reference, US patent **6,493,572 B1** as having been made of record. However none of these references constitute prior art against the claims of the instant application, because applicant's Declaration Under 37 CFR 1.131, which was submitted July 13th 2004, overcomes each of these references since each reference relies of a date of September 30<sup>th</sup> 1999 or later.

### Canceled Claims

8. With respect to **claims 18-24** these claims are canceled as per applicant's May 12<sup>th</sup> 2003 preliminary CPA / RCE amendment.
9. With respect to **claims 27-35** these claims are canceled as per applicant's May 12<sup>th</sup> 2003 preliminary CPA / RCE amendment.
- 10.** With respect to **claims 42-44** these claims are canceled as per applicant's May 12<sup>th</sup> 2003 preliminary CPA / RCE amendment.

### Drawings

11. A New set of corrected drawings are required in this application because the official draftsman has objected to the Formal drawings submitted **June 11<sup>th</sup> 2002 with respect to figures 7 and 8. A complete set of NEW FORMAL DRAWINGS** including any and all examiner approved drawing changes, that have occurred during this examination are now required. [See the attached PTO 948 form of the Official Draftsman's Review.]
12. Applicant is advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

The following is an examiner's statement of **Reasons for Allowance**:

- 13.** With respect to **Examiner amended independent claims 1, 41, 51, and examiner amended dependent claim 11**, Each of these claims are allowable over the prior art of record because the prior art of record does not disclose or suggest a magnetic resonance imaging system coil configuration or method comprising **"a radio frequency pair of coils in an opposite rotation orientation, wherein the pair of coils are associated with a first magnetic field in a region of interest, wherein the region of interest is essentially within a cylinder created by the pair of coils,"** and **"a radio frequency single coil at an essentially zero-flux contour with respect to the first magnetic field, wherein the single coil is associated with a second magnetic field in the region of interest,"** with the proper positioning/detecting **in combination with the remaining limitations of each of the claims.** It is the combination of the claim

limitations taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims.

**14.** The applicant's invention has the single RF coil at the location of the zero flux contour created by the oppositely oriented pair of RF coils. The **prior art of record** fails to teach locating an active, utilizable coil at the claimed location, in combination with the other features of the independent claims. Applicant uses the pair of RF coils which are oppositely oriented and the single RF coil together to generate/detect magnetic fields from both the coil pair and the single coil in combination. In the prior art configurations this arrangement is unknown because in the prior art configurations and methods, an active single coil is not located at the point of zero-mutual inductance because of the inductive coupling which occurs with paired coils. Applicant's coils are oppositely oriented on either side of the single coil which removes the decoupling problem, allowing the single coil to be located at an essentially zero flux contour. The prior art coils of record are oriented in the **same way**, with a single coil in the center which serves as a decoupling coil, [See **McDougall et al.**,] or are oppositely oriented while lacking the actively utilized single coil at the location of the zero-flux contour. [See **Sakakura**].

**15.** With respect to **Examiner amended independent claims 38, 78; and method independent claim 45**, These claims are allowable over the prior art of record because the prior art of record does not disclose or suggest an MRI coil configuration/method comprising "at least five RF coils with bilateral symmetry, **wherein the at least five RF coils are coaxial**, wherein said at least five RF coils are associated with a plurality of modes such that the number of modes is less than or equal to the number of RF coils, wherein said plurality of modes correspond with a plurality of current patterns, **each of said plurality of current patterns having zero net mutual inductive coupling to each of the other of said plurality of current patterns in a region of interest; and detecting magnetic fields associated with the plurality of modes with the at least five RF coils**" in combination with the remaining limitations of each of the claims. It is the combination of the claim limitations taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims.

16. The examiner notes that the applicant's claim requires the at least five coils to be coaxial and **"each of said plurality of current patterns having zero net mutual inductive coupling to each of the other of said plurality of current patterns in a region of interest; and detecting magnetic fields associated with the plurality of modes with the at least five RF coils"**, the zero net mutual coupling for each of the current patterns of the at least five coaxial RF coils is an unexpected feature of applicant's coil configuration that is not found within the prior arts of record. In the prior arts of record there are at least one or more coils within an RF coil configuration of at least five coils that exhibits a net coupling. Applicant's claim requires that each element in the coil configuration have **"zero net mutual inductive coupling to each of the other of said plurality of current patterns in a region of interest;"** this result is not taught, suggested, or hinted at in the prior art. The **McDougall et al.**, reference fails to meet the applicant's claims because all of the coil components have a non-zero mutual coupling to one another, and require a special decoupling circuit to eliminate coupling concerns. It is the unexpected feature of the "zero mutual inductive coupling to each of the at least five RF coil patterns" in combination with each of the other features of the claims that make these examiner amended / independent claims and the corresponding dependent claims allowable over the prior art of record, and provide a novel and non-obvious combination.

17. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### **Prior Art made of Record**

18. The **prior art made of record** and not relied upon is considered pertinent to applicant's disclosure.

**A) Su et al.**, US patent 6,493,572 B1 issued December 10<sup>th</sup> 2002, with an effective filing date under **35 U.S.C. 102 ( e )** of September 30<sup>th</sup> 1999.

**B) McDougall et al.**, US patent 5,680, 044 issued October 1997.



- C) Sakakura** US patent 6,285,188 B1 issued September 2001 filed February 25<sup>th</sup> 1999. This reference fails to have a single coil located as taught by applicant, and is only made up of four radio frequency coils, as opposed to applicant's five coaxial coil configuration.
- D) Taicher et al.**, US patent 6,118,272 issued September 2000, filed July 30<sup>th</sup> 1997.
- E) Vavrek et al.**, US patent 5,311,135 issued May 10<sup>th</sup> 1994.
- F) Mehdizadeh et al.**, US patent 4,918,388 issued 17 April 1990.
- G) Molyneaux**, US patent 5,394,087 issued 28 February 1995 filed 11 August 1993.
- H) Boskamp**, US patent 5,594,337 issued 14<sup>th</sup> January 1997 filed 20 October 1994.
19. The following references are noted for the purposes of a complete record but do not constitute prior art because the earliest date of these references is September 30<sup>th</sup> 1999 which like the **Su et al.**, US patent **6,493,572 B1** reference above have been overcome by applicant's declaration of July 17<sup>th</sup> 2004.
- I) Su et al.**, US patent 6,768,303 B1 issued July 2004.
- J) Su et al.**, US patent 6,751,496 B2 issued June 2004.
- K) Su et al.**, US patent 6,701,178 B2 issued March 2004.
- L) Su et al.**, US patent application publication 2003/0114748 A1 published June 2003
- M) Su et al.**, US patent application publication 2003/0109782 A1 published June 2003
- N) Su** US patent 6,701,177 B2 issued March 2004.

### Conclusion

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

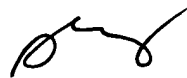
**21.** If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax**

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**phone number** for the organization where this application or proceeding is assigned is  
**(703) 872-9306.**



Diego Gutierrez

TAF

Supervisory Patent Examiner

September 1, 2004

Technology Center 2800